97TH CONGRESS } HOUSE OF REPRESENTATIVES { REPT. No.
2d Session } { 97-523

AUTHORIZING APPROPRIATIONS TO THE FEDERAL AVIATION ADMINISTRATION FOR RESEARCH, ENGINEERING AND DEVELOPMENT FOR FISCAL YEAR 1983

MAY 17, 1982.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

---

Mr. FUQUA, from the Committee on Science and Technology, submitted the following

REPORT

[To accompany H.R. 6193 which, on April 28, 1982, was referred to the Committee of Science and Technology]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science and Technology, to whom was referred the bill (H.R. 6193) to authorize appropriations to the Federal Aviation Administration for research, engineering and development, and having considered the same, report favorably thereon without amendment and recommend that the bill do pass.

PURPOSE OF THE BILL

The purpose of the bill is to authorize appropriations to the Federal Aviation Administration for research engineering and development for fiscal year 1983 as follows:

	Fiscal year 1983
Air Traffic Control	$55,096,000
Air Traffic Control Computer Modernization	47,000,000
Navigation	5,276,000
Aviation Weather	8,068,000
Aviation Medicine	1,250,000
Total	116,690,000

93-535 O

H 703-6

CONTENTS

	Page
Purpose of the bill	1
Committee actions	3
Research, engineering, and development summary:	
Program and performance	5
General statement	6
General justification	7
Summary of requirements by activity	9
1. Air Traffic Control	9
System	9
Beacon	16
Aircraft Separation Assurance	17
Communications	18
Airport/Airside/Landside	19
En route Control	23
Flight Service Stations	25
Terminal/Tower Control	26
Technology	28
Support	30
2. Advanced Computer	31
3. Navigation	32
Navigation	32
Approach and Landing Systems	34
4. Aviation Weather	37
5. Aviation Medicine	39
Sectional analysis	41
Cost and budget data	41
Effect of legislation on inflation	41
Committee oversight findings and recommendations	42
Changes in existing law	44
Congressional Budget Act information	44
Congressional Budget Office cost estimate	44
Oversight findings and recommendations, Committee on Government Operations	45
Committee recommendations	45
FAA recommendation	46

COMMITTEE ACTIONS

Research, Engineering and Development

The FAA requested a total of $133,500,000 from the Airport and Airways Trust Fund for Research, Engineering and Development for Fiscal Year 1983. Contained in this amount is $16,810,000 for regulatory support research. This budget category was funded previously from general revenues. The Committee believes that such activities continue to benefit the public at large and therefore recommends that Trust Funds not be used for this purpose.

Of the remaining $116,690,000, the largest portion is requested for financing the front-end costs of implementing the "National Airspace System Plan". This Plan was produced partly in response to H. Res. 202 which called on the FAA to develop and obtain Administration approval of an urgently needed, long-range program plan to modernize the enroute Air Traffic Control computer system. In response, the FAA took the opportunity to lay out a comprehensive, top-level blueprint for upgrading the entire ATC system. The resulting NAS Plan addresses major shortcomings of the present system and outlines a well conceived strategy for dealing with them. It is a significant and long overdue effort at long-range planning.

The highest priority project in the NAS Plan is modernization of the enroute computer system. This involves replacing obsolete equipment at 20 enroute centers and incorporating other improvements.

Because of the estimated total cost of this effort as well as the implications for air safety, the Committee focused considerable attention on it during its review of the fiscal year 1983 authorization request. The Committee examined the major concerns of user groups and other interested parties. These may be summarized as follows:

1. Validity of FAA traffic growth forecasts. Step 1 of the computer modernization involved "rehosting" the existing software on a modern computer. The purpose is to gain additional computer and memory capacity at certain enroute centers where traffic forecasts indicate impending saturation. Yet, FAA forecasts have frequently been in error. Thus, the argument is made that replacement decisions based on these forecasts may unjustifiably limit the options available for the final modernized system.

The Committee acknowledged this potential, but believes that, in the absence of any better data, it is only prudent to proceed to meet the best available estimate of demand.

2. Means of achieving an interim capacity increase. The FAA plan for rehosting envisions current technology computers as the replacement for the existing IBM 9020's. These would remain as the central processor in the fully modernized system in Step 2.

An alternative is to upgrade the present computers by replacing them at certain centers with a larger capacity version of the 9020. These would then be discarded when the fully modernized system is

brought in. This approach appears to be feasible. It would be less costly in the short run and would allow complete flexibility in designing the final system.

The disadvantages of this approach are that it would prolong and compound the maintenance expenses associated with the current 9020's. It would probably cost more in the long run because the interim hardware would be scrapped. It would involve greater risk. Furthermore, there can be no assurance that the promise of greater design flexibility in Step 2 would lead to any significant productivity or safety benefits.

For these reasons, the Committee recommends proceeding with the NAS Plan for enroute modernization. At the same time, the FAA's Request for Proposals for enroute modernization should be written to allow bidders to propose alternatives such as the interim upgrade or replacing the new host computer if these are cost beneficial.

3. Proceeding with enroute modernization before fully addressing airport capacity and airway procedures. The Committee recognizes the need to correct deficiencies in these areas. But, the need for enroute modernization is widely acknowledged. Accordingly, it should proceed without further delay.

The Committee is concerned about uncertainties in several areas of the NAS Plan:

1. The full development and acquisition costs;
2. The impact of system design on controller and pilot performance;
3. The safety risks in transition to the modernized and consolidated ATC system;
4. The cost to users;
5. FAA management capabilities;
6. Priorities if full funding does not materialize;
7. Validity of productivity estimates;
8. Inattention to the possible use of satellite technology.

On balance, the Committee believes the NAS Plan is an acceptable basis for proceeding and recommends its adoption. Nevertheless, because of the concerns mentioned, the Committee wishes to review its status at frequent intervals. Accordingly, a one-year authorization of $116,690,000 is recommended.

While this Committee fully supports the intent of the FAA to modernize the air traffic control system, it is important that strong Congressional oversight of the NAS Plan and its implementation be sustained. In this regard, the Administrator of the Federal Aviation Administration is requested to submit to the Committee on Science and Technology of the U.S. House of Representatives, not later than December 31, 1982, and annually thereafter, a report that summarizes activities under the NAS program. This should include, but not be limited to, historical data that compares achievements versus plans in terms of productivity, safety, costs, schedules, and milestones. Modifications to the Plan for subsequent years should also be identified.

The Committee has proposed a one-year authorization for the FAA while the Administration is requesting five years. Unlike other R&D programs, the FAA's is closely linked with facilities and equipment implementation. The initial R&D procurements associated with the NAS Plan are critical to the downstream capital investment decision. The majority of the research is near-term in nature and will not be subject to significant technological perturbations in an annual time

frame. While some argue that a multi-year authorization limits the oversight of this Committee, there are some very positive benefits that could accrue from a multi-year authorization. FAA and the industry would have greater confidence in supporting and implementing the long-range plans of the NAS. It would relieve a prevalent skepticism that the Plan will remain entangled in endless annual debates that characterized the plight of an earlier and similar plan in 1972. Finally, it would demonstrate that this Committee has decided that the immediate and continued modernization of the air traffic control system is essential and must proceed now.

Nevertheless, the Committee feels that, at present, it has received insufficient information in the areas indicated above to justify more than a one-year approval.

RESEARCH, ENGINEERING AND DEVELOPMENT SUMMARY

Program and Performance

The Federal Aviation Administration (FAA) conducts engineering and development programs to improve the national air traffic control system and to increase its productivity and capacity to meet the expected air traffic demands of the future. These efforts are based upon exploiting current technology and applying system engineering techniques to the development and integration of new equipment into the total system. The agency also administers aviation medical research aimed at increasing the personal effectiveness of traffic controllers.

These programs are conducted under the direction of the agency's technical personnel, through contracts with qualified private firms, universities, individuals and other Government agencies.

1. Air traffic control.—Existing technology is applied to air traffic control problems to keep the current system operating safely and system improvements are made to increase the productivity and capacity of the current system. These improvements include the surveillance of aircraft by tracking radars and control center processing of flight information received from pilots, airline dispatchers, flight service stations and the surveillance system through a national communications network. The high-speed or real-time, computerized processing of this data for the direct use of air traffic controllers is a key to increasing system productivity.

This program also includes activities designed to insure that the air traffic control system will satisfy the demands of the 1990's, particularly those affecting the interface between pilots and traffic controllers. This work includes developing new traffic control concepts; assessing their technical, economic, and operational feasibility, and conducting selected feasibility demonstrations.

2. Advanced computer.—This activity provides for the development of advanced automation systems which will provide the capacity to accommodate the forecast demands for air traffic control services in the post 1990's. In 1983, $47 million will provide for the first major research contract associated with replacement of the existing 9020 enroute computers and for other supporting research and development programs.

BEST COPY AVAILABLE

3. Navigation.—This activity provides for modernization, expansion, and improvement of the common navigation system facilities in the United States and in overseas areas where international agreements require U.S. participation. The requested 1983 funds will support research and development activities for enroute navigation to assess candidate navigation systems such as NAVSTAR/GPS, LORAN–C, and OMEGA/VLF systems for use in the post-1995 period. Continued research in precision landing aids, flight deck information management and Head-Up Display (HUD) is also planned.

4. Aviation weather.—This activity provides for a program, coordinated with the Departments of Defense and Commerce, to modernize the acquisition, processing, dissemination, and display of weather information tailored to the needs of aviation users. Development of systems for the detection and avoidance of wind shears is also included in this activity.

5. Aviation medicine.—This activity provides for conducting aeromedical research directed toward identifying and eliminating those physiological and psychological factors harmful to personnel engaged in operating the traffic control system or which may jeopardize flight safety.

GENERAL STATEMENT

The Research, Engineering and Development program is comprised of seven major activities: (1) air traffic control, (2) advanced computer, (3) navigation, (4) aviation weather, and (5) aviation medicine. The objectives of this program are to keep the current system operating safely and efficiently; to modernize the system through improvements in facilities, equipment, techniques, regulations and procedures, and to insure that the system will safely and efficiently handle the volume of aircraft traffic expected to materialize in the future.

The realization of these objectives require that the development of future navigation and traffic control equipment begin with the exploitation of current technology. This includes high-speed modular computers, solid state electronics, digital communications, and satellite applications. Some of these technologies will be used or further developed in FY 1983 programs, including development of advanced computers, automated en route air traffic control, and other new and enhanced automated aids for air traffic control.

GENERAL JUSTIFICATION

The Committee authorized a total of $116,690,000 for fiscal year 1983 as shown in the following table:

	Budget authority (fiscal years)	
	1982	1983
Air traffic control	$46,504,000	$55,096,000
Advanced computer	11,240,000	47,000,000
Navigation	8,170,000	5,276,000
Aviation weather	4,786,000	8,069,000
Aviation medicine	1,100,000	1,259,000
R.E. & D. total	71,800,000	116,690,000

BEST COPY AVAILABLE

This request reflects domestic and international requirements to make air travel safer and to increase the efficiency of Air Traffic Control (ATC) systems. The major thrust of the FY 1983 budget request is directed to providing the activities necessary to develop a new automation system necessary to meet the demand for air traffic control services in the late 1980's and beyond; the early completion of the Traffic Alert and Collision Avoidance System (TCAS); the rapid completion of development of the Mode S sensor and the Automatic Traffic Advisory Service (ATAS); continuing the automation programs for en route, terminal and Flight Service Station (FSS) programs; continuing operational demonstration of the Microwave Landing System (MLS); modernizing communications systems; developing radars for the detection and tracking of severe weather; formulating and analyzing concepts for future traffic control systems; and completing programs included in the Department of Transportation (DOT) national plan for navigation. The financial resources needed to meet these major commitments and other future needs include the following:

The sum of $8.4 million for continued development of the Traffic Alert and Collision Avoidance System (TCAS)—$4.3 million for the continued development of Mode S and Automatic Traffic Advisory Service (ATAS)—$2.8 million to continue development of approach and landing systems—$7.0 million to continue development of hardware/software interfaces in the en route and terminal areas—$11.9 million for overall systems engineering validation of technical, economic and operational requirements for future air traffic control systems; and formulating and analyzing concepts for future traffic control systems—$3.4 million for developing computerized flight service station systems which will provide self-briefing capabilities to allow pilots direct access to a computerized weather data base for preflight and inflight weather briefing and flight plan filing—$3.1 million for improving the design, layout and construction of runways—$8.1 million for improving the acquisition, distribution and display of weather data—$2.5 million to evaluate various navigation systems including Long Range Naviation (LORAN-C), Omega and the satellite based Global Positioning System (NAVSTAR/GPS) as supplements to the present Very High Frequency Omnidirectional Radio Range/Distance Measuring Equipment VOR-DME air navigation systems. The LORAN-C, NAVSTAR/GPS, and VOR-DME systems are also being evaluated as candidate systems for the future prime navigational aid—$10.5 million to continue the development of a voice switching and control system and enhancements to the national airspace data interchange network that provides for the transfer of digital data between ground facilities to meet existing and future communication needs—$3.1 million for medical research programs designed to improve the personnel performance and efficiency of air traffic controllers in computerized environment; and $47.0 million for the development of advanced computer systems required to meet the demands for services in the late 1980's and beyond.

The personnel financed under this appropriation are located at the Federal Aviation Administration Technical Center, Atlantic City, New Jersey; the Mike Monroney Aeronautical Center, Oklahoma City, Oklahoma; and the Washington, D.C. offices of the Federal Aviation

BEST COPY AVAILABLE

Administration (FAA). These personnel fall under three general categories: Program Supervision and Contract Management, Test and Evaluation, and Aeromedical Research.

Program supervision and contract management

These personnel are responsible for technical direction and program management. They are directly concerned with the complex program to develop and modernize complete systems (or components of systems) which are needed to improve and expand the current system as well as to develop future systems to increase the capacity of the nation's airport and airway systems. The primary function of these people is to serve as managers of a major technical effort falling within their area of technical expertise. Other areas of technical work require the services of air traffic controllers, computer systems analysts, operations research analysts, meteorologistics and mathematicians.

A prime task of these personnel is to manage and monitor one, or more, development contracts. These will range in dollar value from as small as $5,000 to many millions. The nature and complexity of these contracts, rather than their dollar value, will determine the number which can be supervised by one manager in a manner which protects the best interests of the Government. The contracts cover such subject areas as wake vortex detection systems, collision avoidance systems, improved surveillance systems, enhancements to en route and terminal automation hardware and software systems.

Tests and evaluation

The Federal Aviation Administration Technical Center requires a staff of engineers, air traffic controllers, computer specialists, physicists, pilots, aircraft mechanics and various skilled technicians. These personnel are engaged in project activities in all phases of air navigation, air traffic control, airport design and development, systems evaluation, communications, weather, and aircraft safety. Flight support of projects is provided by airmen flying and maintaining aircraft ranging from small single-engine aircraft to high-performance jet and turboprop aircraft. Some typical test and evaluation projects are: Flight testing and evaluating the performance of collision avoidance systems; conducting continued system tests and demonstrations of microwave landing systems; testing new software programs required to enhance the performance and capabilities of the terminal and en route automated programs; and testing of equipment for use in detecting and displaying wind shear data.

Aeromedical research

The aeromedical research efforts of the agency, conducted at the Civil Aeromedical Institute, are aimed at controlling the biomedical factors that are causes of, or contribute to, control errors and incidents in the National Airspace System (NAS). They are concerned with air traffic control specialists and their work environment. These programs cover all the broader aspects of biomedical factors related to the airways system, including bio-engineering, psychology, physiology, pharmacology, biochemistry and general medicine to determine the adverse effects of disease and physiologically induced deficiencies on the performance of air traffic control specialists.

SUMMARY OF REQUIREMENTS BY ACTIVITY

[In thousands of dollars]

		Activity	Appropriation fiscal year 1982	Request fiscal year 1983
1	01	System	8,675	11,877
1	03	Beacon	4,151	4,274
1	05	Aircraft separation assurance	7,283	8,375
1	06	Communications	4,706	10,464
1	08	Airport/airside/landside	3,412	3,081
1	12	En route	5,863	4,033
1	13	Flight service stations	2,435	3,414
1	14	Terminal	6,038	2,946
1	16	Technology	1,694	3,533
1	21	Support	2,227	3,099
		Total	46,504	55,096
2	23	Advanced computers (total)	11,240	47,000
3	04	Navigation	4,355	2,515
3	07	Approproach and landing	3,815	2,761
		Total	8,170	5,276
4	15	Aviation weather (total)	4,786	8,068
5	19	Aviation medicine (total)	1,100	1,250
		Grand total	71,800	116,690

1. Air Traffic Control, $55,096,000

This activity provides for improving the airways systems by applying existing technology to air traffic control problems to keep the current system operating safely with maximum efficiency and by providing system improvements to increase the capacity of the current system. This activity is broken down into 10 individual programs as follows:

01 System
03 Beacon
05 Aircraft Separation Assurance
06 Communications
08 Airport/Airside/Landside
12 En Route Control
13 Flight Service Stations
14 Terminal/Tower Control
16 Technology
21 Support

01 SYSTEM, $11,877,000

(a) Scope and Objectives

As an integral part of the "FAA Engineering and Development Plan" this program provides the overall systems engineering direction and guidance from which the Federal Aviation Administration (FAA) plans and integrates its research, engineering, and development efforts to meet the needs of a progressively automated National Airspace System (NAS). The newly developed "National Airspace System Plan" and "FAA Engineering and Development Major Program Plan" describe the research, development, and engineering necessary

to support the FAA's modernization and improvement efforts for the total NAS. Specifically, it identifies areas where systems engineering improvements can be applied to reduce, within the NAS, the risks of accidents, delays and diversions, and operational costs. This effort includes evaluations of current air traffic control (ATC) system performance, determination of future performance requirements, development of system engineering designs, development of long-range research programs, requirements studies, benefit versus cost (pay-off) analyses, and defining and describing potential system changes.

This advanced development program also provides for explorations and broad-based research to advance and exploit applications of new technology in an imaginative, continuous, and evolutionary manner which responds to the needs of the aviation community. As such, it provides the necessary resource applications so that current and future system problems and a technically sound basis for new engineering and development initiatives that address the requirements of system users can be identified. The efforts described herein identify the research, development, and engineering which must be completed in order to achieve the ATC upgrading referred to in the "National Airspace System Plan."

(*b*) *Program Status and Planned Accomplishments*

1. Systems Requirements

The objectives of this effort are to: (1) analyze and define the long-term limitations and improvements of various elements of the NAS in terms of capacity, performance, productivity, accommodation of user needs, and environmental considerations; (2) translate forecasts of user requirements into specific capacity levels for all subsystems; (3) identify the time frame when specific subsystems will reach their limitations; and (4) validate current and future airspace separation standards and procedures for continental United States (U.S.) and over-ocean operations.

System Capacity

This effort provides for improvement studies and analyses of the components and procedures that are or are likely to become a part of the integrated NAS. These studies are designed to identify the means to achieve a more energy efficient system through reductions of ATC delays, thereby increasing system capacity and throughput.

Since the airport system, especially the major airports, represents the limiting elements in the NAS, the FAA will continue work to achieve higher capacity and throughput and to reduce delays. The FAA, working with industry, has been active in assessing the current and potential capacity of the major U.S. airports. Capacity and delay simulation models have been developed which have become the foundation for the consideration of both airport and ATC improvements. Studies have been undertaken and a series of potential improvement options identified which may have a significant impact on airport capacity. The options are: achievement of independent Instrument Flight Rules (IFR) parallel approaches to 3,000 feet centerline spacing, operational solutions to wake vortex hazards, dependent IFR parallel approaches at spacings less than 3,000 feet, converging IFR approaches, separate short runways for general

aviation and commuters, and triple simultaneous and dependent IFR approaches.

While the basic technical work is done, work remains to operationally test, evaluate, and establish facilities to implement the most promising airport capacity improvements after acceptance by the user community.

The Runway Configuration Management System was developed to permit the most efficient use of available airport capacity at major airports. The system offers controllers, in the near-term, better information on optimal use of the available runways under a variety of conditions to be encountered (e.g. winds, surface conditions, traffic mix, etc.).

In FY–1980, the basic test model of a Runway Configuration Management System, which provided a means for consistent selection of high capacity/low delay runway configurations, was delivered to the Chicago O'Hare Tower and underwent testing and evaluation to determine its efficiency as a configuration management tool for the tower supervisor. The results of this evaluation indicated that the system had great potential but also had several limitations (e.g., limited real-time data, assignment of realistic values for direct crosswind components and data presentation). In FY–1981, an upgraded Runway Configuration Management System was demonstrated and found acceptable; and in FY–1982, the enhanced Runway Configuration Management System was developed. Installation was initiated at Chicago O'Hare for operational testing and software evaluation.

Tests and evaluations of the enhanced feasibility model of the system will be completed during FY–1983. Additionally, site adaptations of the Runway Configuration Management System will be performed for those airports identified as having the highest benefits to gain with the installation of this system.

Separation Standards

The efficiency of the ATC system depends to a large extent on the separation standards applied to insure safe separation. Safe separation standards depend on the quality of navigation performance, the quality of the ATC surveillance services and the capability of aircraft to operate within given flight technical limits.

This program is a continuing effort to provide improved analytical methods for the validation of current U.S. and international airspace separation criteria as well as procedures and guidance for the establishment of new standards.

An activity currently underway is the study of the feasibility of reducing vertical separation above 29,000 feet from 2,000 feet to 1,000 feet. This activity includes the exploration of various factors related to vertical separation maintenance (e.g., the certification and calibration of aircraft vertical position-keeping systems, and the display and use of Mode C information) and the data collection program to establish the performance of the current heightkeeping system.

In FY–1983, the data collection initiated in FY–1982 will continue; and the evaluation of the adequacy and accuracy of the current high altitude heightkeeping system (including the development of distribution of errors) will continue. A preliminary analysis of the data as

BEST COPY AVAILABLE

well as a preliminary collision risk analysis will be conducted during FY–1983 and will be used to determine the direction of future data gathering efforts aimed at providing the necessary criteria and standards to the FAA's operating services for implementing reduced vertical separation.

In FY–1982, a composite route structure was established between Anchorage, Alaska, and Tokyo, Japan. In FY–1983, a data collection and analysis program will be completed to verify that the anticipated level of safety is being achieved.

In FY–1982, a methodology was developed to review the VOR lateral separation criteria based on high altitude navigation performance data and upon analysis of the improvements provided by the ATC surveillance capability. In FY–1983, revisions to the criteria will be developed and a data collection and analysis actively undertaken to determine the navigation performance of aircraft operating on low altitude VOR air routes. This effort includes the investigation of the primary causes for large navigation errors (plunders). This data will be used to expand the draft criteria to include low altitude operations. Also in FY–1983, analysis of converging and intersecting routes will be performed to determine applicable criteria for such routes.

In FY–1983, data collection on the performance of the Minimum Navigation Performance System (MNPS) in the North Atlantic will continue to develop criteria and methodology for use of MNPS in other areas including oceanic (Central East Pacific and North Pacific) and continental areas as proposed by the European community.

2. System Integration

This is a continuing function whose objectives are to select among alternatives the best methods for improving the system and includes the proper interfacing of new systems and improvements into the current and future NAS.

Advanced Navigation Systems

The Navigation Program fully supports the Federal Radionavigation Plan (FRP) jointly developed by the Department of Transportation and the Department of Defense to define the navigation system for air, marine, and land uses.

The objective of this program is to ensure that the future navigation services required by system users are provided by the agency in an evolutionary and a cost-effective manner. This program provides for technical and economic assessments of candidate radionavigation systems and system mixes for the post-1995 air navigation system. The performance of these candidates (VOR–DME, NAVSTAR/GPS, LORAN–C, and combinations of these systems), determined under the 04 Navigation Program, will be compared with the requirements for the future navigation system. Cost-effectiveness comparisons and technical evaluations of the different systems and their combinations continued in FY–1982 as well as avionics cost analyses.

At the end of 1982 the FAA's preliminary recommendation on the selection of the future radionavigation system mix will be forwarded to the Secretary of Transportation. It is expected that the Secretaries of Transportation and Defense will make their preliminary recom-

BEST COPY AVAILABLE

mendations on future radionavigation system mix to the Office of Management and Budget during FY–1983. There will be support by the FAA in FY–1983 to the Office of the Secretary of Transportation in preparing the final recommendation for the post-1995 Civil Aviation Navigation System. The recommendation will include the plan for implementing the future system.

Activities conducted in the 04 Navigation Program support the FRP and contribute data to be used in making the 1982 and 1983 decisions. The FRP will be updated during FY–1983 to reflect the Department of Transportation's and the Department of Defense's joint recommendations.

Integrated Flow Management

The management of aircraft flows to achieve efficient operations and to save fuel has been a part of the FAA's system for a number of years. A number of procedures are in use and are managed by the agency's Central Flow Control Facility. Fuel Advisory Departures, which save fuel by requesting aircraft to stay on the ground when they cannot be served at their destinations, is one of these. This procedure operates in conjunction with other techniques to manage the flow of traffic.

Recognition that the management of the flow of air traffic must encompass nationwide aircraft flow, en route metering, terminal metering, and sequencing and the best information on current and predicted airport capacity and throughput has generated a need for an FAA system integration activity called the Integrated Flow Management Program.

This program provides a focal point for all activities that impact aircraft traffic flow and ensures that these activities are integrated into a total system concept. This program also provides for the development of flow management concepts and processes that are designed to reduce fuel consumption by optimizing the flow of air traffic and establishing effective delay management procedures. En route metering is a significant part of this program.

An important element of Integrated Flow Management is the development of an automated planning capability for the terminal area that considers the interaction and operational interrelationships of the runway and taxiway system and the terminal airspace. It will also optimize the arrival and departure flows through a direct automated interface with an enroute metering, the Center departure sectors and the Central Flow Control Facility. This program includes development of a terminal planning capability which will encompass the runway configuration management element, the airspace configuration management element, plus arrival and departure metering software. This portion of the Integrated Flow Management development will utilize information derived from FAA's earlier work on automated metering and spacing. The latter element of this program will be an exploratory research and development effort leading to automatically generating clearances and clearance directives for optimal use of airport, airspace and runways.

In FY–1982, a concentrated effort was placed on further defining the integrated flow management concept. Emphasis was placed upon

integrating available flow management capabilities into an effective flow management system.

During FY–1983, development of the terminal portion of the Integrated Flow Management System will be initiated.

3. System Economic and Safety Analyses

The objectives of this overall system effort are to evaluate alternatives for system improvement and innovation through benefit versus cost, safety, and performance improvement analyses.

In FY–1982, a system of cost-benefit study was completed which looked at various options for upgrading and replacing the en route ATC computer systems.

In FY–1983, benefit versus cost studies quantifying the impact of Automated En Route ATC and Integrated Flow Management on the overall ATC system will be completed.

4. Advanced Systems Concepts

The objective of this effort, which draws much of its impetus from the results of systems requirements and advanced technology efforts, is to design and evaluate advanced automation concepts and approaches to meet NAS needs. Included are the development and evaluation of new techniques, concepts, and designs for advanced cockpit information systems.

Automated Airport Services

A requirement for automated airport services was identified in the "National Airspace System Plan." Work by FAA and NASA has established the feasibility of providing certain ATC tower and terminal airspace functions automatically. Such a service may be achievable at locations which do not yet qualify for tower service but where certain limited services are needed. Research and engineering design work will continue to postulate and then develop a viable automated airport service system. In FY–1982, this will consist of initiating system design efforts and determining the applicability of existing hardware systems for use in an automated airport service system.

In FY–1983, work will begin on the development of a test system.

Automated En Route Air Traffic Control

The goal of providing automation of the ATC process to permit aircraft to fly optimal fuel efficient profiles, to increase system safety and capacity, to increase controller productivity, and to reduce system errors is an important element of the "National Airspace System Plan." The Automated En Route Air Traffic Control System (AERA) will automatically probe aircraft routes, detect and resolve conflicts with other aircraft, restricted areas, or severe weather, and automatically issue clearances to aircraft thereby ensuring safe metered and fuel efficient traffic flow. The AERA development will result first in automation tools to aid the controller in preparing and issuing fuel-efficient clearances and direct routings. This portion will be a part of the initial implementation of the new system. Computer algorithms which perform automatic conflict probe and resolution will free the controller of the responsibility of time critical moment-by-

moment detection and resolution of conflicts. The project, which is described as AERA, is in a number of respects an integration of other developments, and will consolidate those developments in enhanced form. It will integrate the flow management functions discussed earlier.

During FY–1982, the major Automated En Route Air Traffic Control Program activities included: preparation of full AERA data processing requirements as input to the en route computer Host specification; preparation of functional and performance specifications for the initial en route AERA enhancement package as input to the advanced computer system specification; testbed demonstrations, refinements and enhancements of AERA capabilities, including a series of man-machine experiments.

In FY–1983, as part of defining the remaining future NAS enhancement packages, preparation of detailed design specifications will be initiated. This activity will be completed in FY–1984.

In FY–1983, we will also expand the AERA testbed automated planning capabilities to include the rerouting of traffic flows by expanding the clear weather algorithm to accommodate system anomalies; such as, severe weather and airport closure.

Cockpit Systems Engineering

The objectives of this program are to evaluate the advantages and disadvantages of cockpit traffic displays in an operationally realistic environment and its impact on the pilot, controller, and the ATC system. This program is designed to provide research results which are directly usable for defining those functions that the pilot can realistically perform using cockpit information and to address the impacts of cockpit displays of traffic information on safety, efficiency, and capacity in the aviation system. This program complements and is fully coordinated with the pilot and controller information analysis efforts conducted under Program 16, Applied Human Facts (the traffic information and workload data are used in the Aircrew Performance Enhancement and Error Reduction Program to determine the overall cockpit workload in full mission simulations and flight tests. The other elements include navigation and flight path control, alerting and warning, and communications, and involve elements in Program 07, Approach and Landing Systems).

During FY–1982 and FY–1983, cockpit display of traffic information studies and simulations were conducted to evaluate pilot monitor roles and to initiate pilot cooperative role studies.

Satellite System Applications

The objectives of this program are to assess the potential applications of satellite technology vis-a-vis alternate technologies and procedures to perform communications, navigation, and surveillance functions. It includes GPS applications analyses in the areas of coverage, reliability, integrity, user equipment cost, and operational acceptability.

In FY–1982, evaluations of alternative solutions for improving air traffic control communications, navigation, and surveillance func-

tions continued. This activity included evaluations for implementation of data link, considering the ATC value of both high frequency (HF) and satellite (Inmarsat) options, automatic dependent surveillance, improved controller displays and the Traffic Alert and Collision Avoidance System as near-term improvements to the oceanic ATC system. This activity will continue through FY–1983.

03 BEACON, $4,274,000

(*a*) *Scope and Objectives*

After reviewing air traffic trends in the late 1960's, the Federal Aviation Administration (FAA) convened a panel of aviation experts from industry, government, and academia to look into the future and recommend improvements to the existing air traffic control (ATC) system. In its report, the panel (called the Air Traffic Control Advisory Committee (ATCAC) recommended, among other things, an improved surveillance system to replace the present ATC beacon system which has known limitations. According to the report, these improvements are needed to meet the increased demands for service from an expanding aircraft fleet and to provide a means for improving communication between the ground and aircraft.

FAA's development in response to the panel's recommendation evolved into a system called Mode-S. The system is designed to permit discrete addressing of aircraft which provides for improved surveillance information flowing to the controllers and an integral data link capability which is essential to FAA's future automation system. Moreover, Mode-S is designed to be totally compatible with the present air traffic control system, avoiding disruptive transition interruptions.

Three engineering models have been fully tested and evaluated and development activities completed. A technical data package to support production procurement has been issued.

During FY–1982, ICAO adopted the discrete address signal format upon which future improvements to beacon systems will be based.

(*b*) *Program Status and Planned Accomplishments*

Mode-S

In FY–1982, support to the operating services associated with the Mode-S sensor procurement and implementation was continued. These activities concentrated on the validation of systems parameters and the establishment and testing of interface configurations for integration with operational terminal ATC systems. The development of an automated Mode-S Transponder Performance Analyzer was also completed.

In FY–1983, the validation of system parameters initiated in FY–1982 will proceed; and functional, operational, and system tests in support of Mode-S implementation will be continued. The Mode-S test bed will continue to support Data Link and TCAS testing.

Automatic Traffic Advisory Service

In FY–1982, the development of the Automatic Traffic Advisory Service (ATAS) was completed and ATAS Computer Program Functional Specification (CPFS) issued. A preliminary version of ATAS

was integrated with the Mode-S test bed at the FAA Technical Center. Subjective pilot evaluations were initiated in FY–1982 using the preliminary ATAS in parallel with the design and implementation of the final version of the ATAS based upon the CPFS. Simulation studies were also initiated to validate and optimize ATAS logic and site adaptation techniques. A draft National Standard for ATAS was published in the Federal Register for public comment.

During FY–1983, the initial evaluation of the ATAS function will be completed and the final ATAS software will be implemented in the Mode-S test bed. Technical and operational tests of the final ATAS will be initiated. The proposed ATAS National Standard will be published in the Federal Register for public comment.

05 AIRCRAFT SEPARATION ASSURANCE, $8,375,000

(*a*) *Scope and Objectives*

The Federal Aviation Administration (FAA) is developing a comprehensive midair collision avoidance capability which will provide an independent airborne solution to the midair collision problem. It encompasses development of a Traffic Alert and Collision Avoidance System (TCAS), a new capability which draws on all previous FAA collision avoidance efforts and is fully compatible with the existing and future Air Traffic Control (ATC) system. The new system will provide a range of capabilities and costs which will meet the requirements of all airspace users and will be designed to operate independently of the ground system. The goal is to develop systems which can supplement the existing ground-based ATC system (when operating within the system) and to provide new midair collision protection in areas not now served by the ATC surveillance system.

The TCAS is being designed to be compatible with the signal format of the present ATC Radar Beacon System and the Mode-S system. TCAS will be developed to provide two compatible capabilities: tion aircraft and TCAS II, a larger, more sophisticated air carrier version. TCAS I, or "Minimum TCAS," as it is called, will provide a general aviation pilot with an alarm when it detects signals from proximate aircraft carrying TCAS or beacon transponders. The minimum TCAS also displays information from TCAS II aircraft with which it has potential conflict. More sophisticated versions of TCAS I will include a display which can provide additional information related to range bearing and relative altitude of appromixate traffic.

The air carrier version, TCAS II, will provide the pilot with detailed information about all Mode-C transponder-equipped traffic in his area and provide resolution advisories to the pilot. TCAS II is designed for reliable operation in high density airspace.

(*b*) *Program Status and Planned Accomplishments*

During FY–1982, design guidelines for the TCAS I were developed; and a draft National Standard for TCAS II was published for public comment. In addition, detailed operational evaluations of TCAS II concepts and associated operational procedures were initiated.

In FY–1983, TCAS II enhancements (horizontal miss distance filtering and horizontal maneuvers) based on using directional antenna

93-535 O - 82 - 2

BEST COPY AVAILABLE

data will be incorporated into the avionics. Operational evaluations of TCAS II equipment will also continue. Commercial TCAS I equipment will be available for installation on general aviation aircraft in 1983, and commercial TCAS II equipment is expected to be available by 1984.

06 COMMUNICATIONS, $10,464,000

(*a*) *Scope and Objective*

The Federal Aviation Administration's (FAA's) communication network not only provides continuous voice communications between the air traffic controller and the pilot but is also responsible for the transmission of pertinent flight plan data, weather, and facility status information among facilities of the air traffic control (ATC) system. While past expansion and automation of the ATC system stressed enhancing capabilities of the entire supporting communication system, future ATC plans require modernizing, expansion, or replacement of much of FAA's communication equipment, including initiation of developments to provide air-ground data-link service to aircraft. Projects include development of a replacement voice switching system for centers and the proposed terminal hubs, upgrading the existing data systems, and the design for Mode-S air-ground data link services.

(*b*) *Program Status and Planned Accomplishments*

Communication System Design

These activities incorporate the overall systems analysis to assure concept and design integrity of all communication's developments. In FY–1982, network studies were continued to assess how the FAA's voice and data communication system should evolve to enable it to meet the needs of future automation. In FY–1983, design will continue on additional enhancements related to the interface requirements for the advanced computer system, aviation weather, data link netting, and the flight service automation program. Emphasis will be placed on network flexibility and reliability and the assessment of alternative methods of providing network backup capability.

Voice Communication System

This system provides switched voice communications between controllers at adjacent ATC facilities and between controllers and pilots over air-ground radio outlets. In FY–1982, system studies were conducted and work initiated on a specification for the development of a new Voice Switching and Control System (VSCS) to replace the switching system currently used in the en route centers.

During FY–1983, this specification will be completed; and a request for proposals to develop the new VSCS will be released. These switching systems will be incorporated into the new controller sector suites being developed in the Advanced Automation Program (23).

Data Communications System

This system provides the ground-to-ground transfer of digital data between FAA facilities, and military and commercial facilities both domestic and international and, in the future, the ground-to-ground portion of the air-to-ground transfer between FAA facilities and aircraft in flight using the Mode-S capability. In previous years a system

called the National Airspace Data Interchange Network (NADIN) was designed to provide for the transfer of digital data between ground facilities to meet existing communications needs as well as to provide for modular expansion to meet future needs. In FY–1982, the design and technical data package for the NADIN enhancement to support the remote maintenance monitoring system was completed. In addition the system design analysis studies aimed at characterizing the data automation communication requirements for the future ATC system continued.

In FY–1983, the design of enhancements of NADIN to support data transfer between Air Route Traffic Control Centers will be completed.

Data Link

The air-to-ground transfer of digital data will be accomplished by means of the data link capability of Mode-S. Studies of the use of this data link to provide aviation related services to in-flight aircraft were undertaken in prior years. A list of near-term candidate data link services was prepared and experiments were begun to permit further design of these services. These near-term candidates include ATC services and various weather products which the pilot can request in-flight. In FY–1982, the development of near-term services and a test facility at the FAA Technical Center continued. Development was initiated on another near-term service, Sector Handoff, which has the potential of improving controller productivity. Development of a data link National Standard was initiated to provide an early input to industry to guide potential development of commercial data link avionics.

In FY–1983, the data link test facility will be fully integrated with the Mode-S sensor and with a variety of data sources. Development activity will begin to incorporate the sector hand-off service which includes assigned altitude, new communications frequency, and next waypoint into the test facility. In addition, a service to automatically deliver flight plan clearances to pilots will be developed and evaluated in the data link test facility. Integration of data link into the National Airspace System will be studied. A full capability airborne test facility to support operational test and evaluation of data link services will begin operating. The data link capability will be implemented as service packages. The implementation of the sector handoff data link service package is planned for 1987. This will be followed by Package II services, Minimum Safe Altitude Warning, altitude assignment confirmation, and weather products in 1988.

08 AIRPORT/AIRSLIDE/LANDSLIDE, $3,081,000

(a) Scope and Objectives

Airports provide the necessary facilities and services for aircraft landings and takeoffs making them vital to the safe and efficient operation of the Air Traffic Control (ATC) system. As a principal mode of intercity travel, air transportation has experienced phenomenal growth over the past three decades. Although the United States' airports system has accommodated these increases safely and efficiently, the demands of heavy traffic are beginning to take their toll on the physical condition of airport facilities and on airport capacity. By 1989, total aircraft operations at Federal Aviation Administration

(FAA)-towered airports is forecasted to reach 93.3 million, a 35 percent increase compared to 69 million in 1979. To help meet this growth, FAA will have to improve present facilities and operational procedures by initiating various research and development programs.

A major element of one of these programs (airport/airside), for example, addresses new and improved design, maintenance, evaluation, and construction techniques that could result in stronger, more durable, and less expensive airport pavement. Close examination of these techniques is important because: over 50 percent of the total annual Federal Airport Grants-in-Aid Funds have been allocated to airport pavement and rehabilitation in the past and also because the FAA's National Airport System plan projects that 62 percent of eligible development costs between 1983–1989 will be needed for airport paving.

Other elements of the program are devoted to improving runway lighting, visual aids, skid-resistant pavements, and snow and ice removal systems. In addition, the program is also involved with research and evaluation of design guidance to accommodate the elderly and handicapped in airport terminal buildings.

The airport/airside program is also concerned with the impact of aircraft trailing wake vortices on terminal area traffic. Because these vortices disrupt efficient and effective terminal air traffic management, airport capacity gains and delay reductions can be realized by minimizing their effects.

This program also includes the activities to address the major factors associated with landside capacity restrictions and the development of practical measures to increase airport terminal capacity. These solutions will ultimately lead to reductions in passenger inconveniences and traveling costs along with the reduction of negative impacts on the overall quality of air travel. The airport capacity and delay program provides technical support to Airport Improvement Task Forces which are formed at major airports to study near- and long-term improvements which will increase airport capacity and reduce aircraft delays.

(*b*) *Program Status and Planned Accomplishments*

Airport Construction

A substantial portion of resources for this element of the program in past years has focused on pavement nondestructive testing and evaluation procedures. In FY–1981 and FY–1982, the emphasis was changed to one of updating current pavement design procedures.

Passenger demand at major airports has led to increases in aircraft operations. When this occurs, the design life of an airport pavement can be materially shortened. A study of the impact that high frequency heavy jet operations has on normal pavement life was initiated in FY–1981 and will continue through FY–1983. Present design guidelines will be reviewed and updated.

An important aspect of runway maintenance is removal of rubber deposits in the heavy traffic areas. The deposits are potential hazards as they become slippery when wet. In FY–1981, a project was initiated to investigate problems and evaluate potential alternative processes for the removal of rubber deposits left on porous friction surface coarse runways. This effort was continued in FY–1982, and in FY–1983 will

direct specific attention on making removal applications operationally and environmentally acceptable.

Surface cracking (reflective cracking) is common to asphaltic overlays. Such a condition can accelerate pavement deterioration. In FY–1981, an investigative effort into the application of woven and nonwoven engineering fabrics to prevent or retard reflective cracking was initiated to provide the basis for the development of a design methodology for pavement overlay construction. Progress was made in FY–1982 to determine the circumstances under which such materials can be applied during pavement construction. Follow-on efforts in FY–1983 will address the material characteristics which nonwoven fabrics must possess to be effective as crack arresting devices on airport pavements.

In FY–1982, techniques were developed to determine whether a newly constructed bituminous pavement section meets contract specifications. In FY–1983, validation of the previously developed recommendations related to incorporation of price adjustment factors into FAA's bituminous pavement surface course specification will be conducted.

Two current projects that hold great promise for improving the state-of-the-art of pavement design are Frost Predictive Technique Methodology and the Rigid Pavement Overlay Thickness Criteria. Substantial laboratory and field tests were conducted in FY–1982 to collect data on the behavior of pavements and subgrade materials during freeze-thaw cycles, since it can have a weakening effect on the integrity of the pavement subgrade. Further field and laboratory testing will be conducted in FY–1983 to develop a mathematical model to predict the characteristics over a range of pavement sections during freeze-thaw cycles.

FAA pavement overlay thickness criteria for rigid pavements is over 10 years old. Shortcomings in the current design criteria are evidenced by deterioration prior to expiration of design life. Proposed new criteria was finalized in FY–1982. Field testing of the proposed criteria will be completed by the FAA in FY–1983 prior to recommending changes to the existing standard.

Also in FY–1983, a new project will pursue the techniques and procedures to improve the quality of pavement construction materials in use today and to explore sources of new materials which meet the necessary strength, durability, and cost reduction factors.

Accommodation of Handicapped and Senior Citizens in Airport Terminal Buildings

This program is the result of the Rehabilitation Act of 1973 which mandated facilitation of the movement of the elderly and handicapped through the airport. During FY–1981 and FY–1982, a survey to determine what the problems of the handicapped and elderly are and to evaluate the solutions to these problems was completed for incorporation into revised design standards/advisory circulars.

Airport Capacity and Delay

In the area of airport capacity analysis, the FAA has developed a family of computer models for use in the analysis of the capacity of an airport. These models can be used to determine the capacity and

delay at airports and to study the relationship of capacity and delay under specific airport conditions.

In FY–1982, data collected in FY–1981 on 10 airports were compiled into a data base to support FAA efforts in airport capacity projects and related studies. The available airport simulation models were also improved to support these studies and future task force studies.

The current rebuilding of the Air Traffic Control System will inhibit conducting any significant task force activities in FY–1983.

Airport Safety Support

Projects on lighting and marking focus primarily on the evalution of different systems to provide better alignment and approach slope guidance to pilots under visual conditions. Test and evaluation of marking and lighting systems for unpaved runways at general aviation airports will continue in FY–1983. Extensive work has already been initiated on the use of reflective markers to improve the quality of nonprecision night approaches and to provide better nighttime cues to pilots as to the locations of runway exits. In FY–1983, test and evaluation will continue on this project. A program to investigate heliport marking, lighting, and visual approach aid systems will be initiated in FY–1983.

Runway Traction

The runway surface traction program will continue to address the interaction between tire and pavement. Evaluation of the traction qualities of asphaltic grooved surfaces was undertaken and completed in FY–1982 in connection with a previous project for concrete pavements. The study of drainage characteristics of different grooving designs was completed in FY–1982. In FY–1983, investigations into the effect tire characteristics and runway surface conditions have on aircraft braking will be initiated. The results will be used to determine methods to predict aircraft braking on a specific runway over a range of weather and surface quality conditions.

Wake Vortex Avoidance

In FY–1982, three reports were published and provided to the operating services: Decay of 707H and DC–8H Vortices, Analysis of Vortex Decay Data (ORD), and Analysis of Long-Lived Vortex Data (Parallel Runway Impact). Joint FAA/NASA research on aerodynamic techniques for vortex alleviation was continued.

FY–1983 investigations of advanced sensor technologies to effectively detect and track wake vortices will be continued under Program 16. Based on the identification of viable sensor technology, a program will be initiated to provide for the development of a system design for an operational advanced vortex system. NASA research on alleviated airfoil design and upset hazard criteria will continue.

Landside

The FY–1982 work in the airport landside area resulted in dissemination of the recently completed Airport Landside Simulation Model (ALSIM) to interested industry groups and completion of a multiyear program plan for R&D efforts in this area.

In FY–1983, the ALSIM capability will continue to be made available to airport operators as a tool in their evaluations of possible improvements in terminal operations.

12 EN ROUTE CONTROL, $4,033,000

(a) *Scope and Objectives*

The objective of the En Route Control Program is to provide for engineering and development of improvements to the existing en route automation systems that will result in increased safety, improved controller productivity, improved control efficiency for reducing en route fuel consumption, and expanded system capacity. Developments accomplished in this program are intended to be incorporated into the en route system in the near term and thereby form part of the baseline that must be accommodated in the planning for introduction of advanced en route computers (see Program 23). Specifically, the en route Electronic Tabular Display Subsystem (ETABS) is required to provide inputs to the sector suite specification.

The basic en route automation system was installed in the air route traffic control centers during the late 1960's and early 1970's. Its initial capabilities included the automatic processing and distribution of Instrument Flight Rules (IFR) flight plans; automatic beacon and radar tracking of controlled aircraft; and presentation of aircraft location, identify, speed, and altitude on controller displays. Since that time, the system has been significantly enhanced by products from this development program, including an automatic conflict alert function to warn controllers when two aircraft are approaching a possible conflict situation, and a minimum safe altitude warning function which warns the controller when an aircraft is approaching a hazardous low-altitude situation. Another important new function, En Route Metering, has recently been completed. This function provides automation aids to controllers to enable more fuel-efficient management of en route aircraft transitioning into terminal areas. Other recently completed projects include experimental software to process Mode-S surveillance inputs.

(b) *Program Status and Planned Accomplishments*

Computer Software Development Support

This program area provides the efforts at the FAA Technical Center to accomplish the day-to-day technical management of software development during design, coding, and testing of en route system enhancements. During FY–1982, computer software development support was provided for implementation of En Route Metering software integration and testing of the ETABS and development of conflict resolution software.

During FY–1983, computer software development will be continued for evaluation and testing of ETABS, development of conflict resolution software, and conflict alert enhancements.

Program Planning and System Engineering

This provides for system engineering contractor support to assist the FAA in formulating detailed design and evaluation requirements for improvements to the En Route ATC Automation System. This support also includes analysis of requirements for interfacing the en route system with other programs and estimation of computer resources required for new automation functions. During FY–1982,

system engineering support was continued for design evaluation of en route software for Conflict Alert Mode C Intruder, Conflict Resolution Advisory, and for experimental work on improving the data entry techniques available to radar controllers, and ETABS evaluation.

In FY–1983, system engineering support will be provided for conflict alert improvements, Conflict Resolution Advisory, and ETABS evaluation.

Conflict Alert for IFR/VFR Encounters

An automatic conflict alert function to warn controllers when two controlled Instrument Flight Rule (IFR) aircraft are approaching a possible conflict situation, is currently in use in the NAS En Route Air Traffic Control (ATC) system. This software enhancement extends the conflict alert function to include cases where IFR aircraft are approaching potential conflict situations with Visual Flight Rule (VFR) aircraft equipped with altitude reporting (Mode C) transponders.

Early in FY–1983, development of field implementable software for this IFR/VFR enhancement will be initiated, and the computer program design specification will be completed. The field implementable design will be optimized to minimize false alarms and computer resources.

Conflict Resolution Advisory

The Conflict Resolution Advisory function is being developed to provide an additional level of safety assistance to the controller. This function will build upon conflict alert logic previously implemented and will provide the controller with a range of computer-generated advisories that he can issue to pilots to safely resolve a possible conflict. In FY–1981, the functional specifications were completed. During FY–1982, contractual action was initiated to obtain the computer programming support necessary for software development; and design specifications for computer programming of the developmental version of this function was also initiated. In FY–1983, design specifications will be completed; and coding of computer programs will be initiated.

En Route Metering

The objective of the En Route Metering development is to provide automation aids to the controller to enable more efficient management procedures, including delay absorption and fuel-optimized descent profiles, for en route aircraft transitioning into terminal areas. During FY–1982, testing and evaluation of this function was completed. Conversion of the function for field implementation will be completed in FY–1983. In addition, work was initiated in FY–1982 to provide enhancements to En Route Metering to adjust for delays taken at the departure airport. In FY–1983, effort to develop this software enhancement to En Route Metering will continue.

Electronic Tabular Display Subsystem

A substantial amount of en route controller workload is required for the manual handling and computer inputs associated with the paper flight progress strips that contain flight plan data for aircraft in each en route control sector. In FY–1982, the engineering model of an Electronic Tabular Display Subsystem (ETABS) was delivered to the

FAA Technical Center and interfaced with the en route central computer complex for initial testing and evaluation.

During FY–1983, initial engineering and operational testing and evaluation will be completed and the technical data utilized as a basis for the section suite development described in Program 23.

Facility Consolidation Simulations

During FY–1983, simulation analyses will be performed to assess the impact on the en route replacement computer system (Program 23) of facility consolidation alternatives.

13 FLIGHT SERVICE STATIONS, $3,414,000

(*a*) *Scope and Objectives*

The existing Flight Service Station (FSS) system, comprised of 317 facilities in the conterminous United States, Alaska, Hawaii, and Puerto Rico is an obsolete, labor intensive system. Expansion of the system to meet the forecast demand for flight services, which are expected to double by 1995, is not economically sound. A major increase in staffing and funding levels would be necessary in order to expand the present manual system to meet the projected demand. These additional resources would not provide improvements in the quality, timelines, or types of services to the aviation community.

The approved "Flight Service Station Automation Program Plan" provides for the automation of 61 FSS's. These stations will initially handle over 50 percent of the total FSS workload. In addition, the plan provides for the consolidation of the remaining stations into the 61 automated facilities. Automation will be developed and implemented in three unique steps—Model 1 (limited specialist automation), Model 2 (full specialist automation with limited direct user access capability), and Model 2 Enhancements (full direct user access capability). Implementation of the automated system is expected to be completed by the 1988 time frame. By that time pilots directly accessing the FSS Automation System through a variety of self-briefing techniques for preflight and in flight weather briefing and flight plan filing will be the primary mode of operation.

The R&D program provides for the concept development, test, evaluation, specification and systems engineering to add enhanced direct users access capability, and other system enhancements to the Model 2 FSS Automation System. The approach will be to evaluate enhancement concepts and specify the functional requirements as enhancement packages to be integrated into the Model 2 FSS Automation System. Expected advancement packages at this time include the following: Package 1, Voice Response System (VRS) and expanded self-briefing terminal access; Package 2, Center Weather Service Unit (interface, flight plan filing and expanded VRS weather products; Package 3, broadcast inflight weather data via VHF Omni-Range, Automated Route Forecasts; and Package 4, automatic Direction Finder Flight Service Automation System computation and new Weather Message Switching Center interface/functions.

(*b*) *Program Status and Planned Accomplishments*

In FY–1982, the design code, test, and acceptance of the first three Model 1 systems (Systems Support Facility at the Federal Aviation

BEST COPY AVAILABLE

Administration (FAA) Technical Center, training system at the FAA Academy, and the first operational field site at Indianapolis Center) was accomplished; and Model 2 system design was completed. Research and development related to direct user access continued with the release of a Request for Proposal for the design of a VRS and design of interfaces for user-owned, commercially available terminals that will be integrated with the FAA Technical Center's Model 2 system as a Package 1 enhancement. The ongoing VRS demonstrations in the Washington, D.C., and Columbus, Ohio, areas were expanded by the addition of Transcribed Weather Broadcasts Route Forecasts and Significant Meteorological Information to the existing products already under evaluation by users. A final report on specialists evaluations of the Geostationary Operational Environmental Satellite system data for FSS use was completed.

During FY–1983, the output of the FSS development effort will result in a contract being awarded for Model 2 Package 1 Enhancements for design of VRS and interfaces for user-owned commercially available terminals. The evaluation report on the applicability of using the jointly developed National Weather Service/FAA aviation route forecast system in conjunction with direct user access will be completed. A final report on automated flight plan filing evaluation will be completed. The Request for Proposal will be released for Model 2 Enhancements Packages 2 and 3 for the design of additional VRS products, Aviation Route Forecast, data link interaction, flight plan input via VRS and user-owned terminals and support of the Center Weather Processor.

14 TERMINAL/TOWER CONTROL, $2,946,000

(a) Scope and Objectives

The Terminal/Tower Control Program provides for the engineering of improvements to the existing terminal automation system and for the development of new system capabilities that will result in increased safety, improved controller productivity, and reduced fuel consumption by air traffic in the terminal control areas. Implementation of the basic Automated Radar Terminal System (ARTS) III at 63 medium- and high-density terminals was completed in 1975. These systems provide the capability to track controlled airborne traffic using beacon replies, and display to the controller the aircraft position with alphanumeric data tags to indicate identity, altitude, and speed. Since 1975, the products of this development program have provided significant enhancements to the capabilities of the ARTS III system. These enhancements include: automated conflict alert, minimum safe altitude warning, tracking of aircraft that are not equipped with transponders, and hardware and software to enable fail-safe operations. An operational evaluation was completed for an expanded ARTS III system which has the capability to process digitized inputs from a remotely located radar and to display the processed air traffic data on all-digital displays in the radar control room and in tower cabs at satellite airports located within the surveillance coverage area. This provided much of the basic experience needed to formulate an evolutionary development program leading to the all-

digital terminal automation system of the future. Further automation improvements to be provided include the Tower Cab Information Displays (TIDS) which will consolidate the critical environmental data displays in tower cabs and radar control rooms and to provide improved flight data displays. The TIDS and Tower Cab Display Systems are required to provide inputs into the sector suite specification (see Program 23).

In addition to ARTS III, the Terminal ATC program includes the development of improvements for the ARTS II systems which are located at low- and medium-density terminals. The improvements include tracking of beacon-equipped traffic, conflict alert, and minimum safe altitude warning.

(*b*) *Program Status and Planned Accomplishments*

Computer Software Development Support

This program area provides the efforts at the FAA Technical Center to manage the day-to-day activities related to the development of terminal system software enhancements. It includes the review of design documentation, identification of necessary changes, and acceptance of testing contractor produced software.

During FY–1982, computer software development support was provided for development of ARTS II safety enhancements, ARTS IIIA/Mode-S interface, Conflict Alert enhancements, and preparation of specifications for terminal functions to be incorporated in the planning for the ATC Computer Replacement in Program 23.

During FY–1983, software development support will continue for the ARTS–II and ARTS–III enhancement programs.

Program Planning and System Engineering

This provides for system engineering support to assist in formulating design requirements for improvements to Terminal ATC Automation Systems. This support also includes analysis of interface requirements between the terminal systems and other development programs, and analysis of system performance during system test and evaluation at the FAA Technical Center. In FY–1982, efforts included conducting design reviews for ARTS II enhancements, preparation of technical plans for the TIDS, and development of Conflict Alert enhancements.

In FY–1983, efforts will include evaluation of the TIDS, test and evaluation of ARTS II safety enhancements, and new software for Conflict Alert enhancements.

Tower Cab Information Displays

The TIDS will provide for the processing and display of critical environmental data (e.g., runway visual range, altimeter setting, and wind and weather data) and flight data in the tower cab. Flight data displays will be evaluated as a replacement for paper flight progress strips and the Consolidated Cab Display (CCD) system will replace the multiple and diverse displays now operating in tower cabs.

In FY–1982, the development of the CCD system will be completed; and the system will be installed at the FAA Technical Center for test and evaluation. Flight Data Displays for use in the tower cabs will also be delivered to the FAA Technical Center. In FY-1983, the opera-

tional evaluation of the CCD system at a field site will be completed, as well as a human factors evaluation of Flight Data Displays. The results will be utilized in the sector suite development in Program 23.

ARTS II Enhancements

An operational requirement has been established to add the safety enhancements of conflict alert and minimum safe altitude warning to the ARTS II system, and also a capability to introduce simulated aircraft into the system for use in controller training. To enable these functions to be developed, it is also necessary to expand the computer capacity of the ARTS II system and to add the capability to track beacon-equipped aircraft. In FY–1982, the computer enhancements necessary to upgrade the speed and memory of the ARTS II system were designed and verified. In addition, development of the software enhancements was initiated. In FY–1983, testing and evaluation of the expanded computer for the ARTS II system will be accomplished; and development of the software enhancements will be nearing completion.

Terminal Automation Test Facility

The Terminal Automation Test Facility (TATF) is located at the FAA Technical Center at Atlantic City, New Jersey, and is used in the development, test, evaluation, and integration of advanced Terminal ATC software systems.

In FY–1982, the TATF was used to support the software development for the ARTS III system, Sensor Receiver and Processor (SRAP) enhancements, Conflict Alert enhancements, and Mode S interface. In FY–1983, operation of the TATF will provide for continued Terminal ATC software development for ARTS II and TIDS.

16 TECHNOLOGY, $3,533,000

(*a*) *Scope and Objectives*

This program provides for the evaluation of advanced technologies and their applications to the present and future National Airspace System, especially in the fields of data processing and displays, sensor development and applications, and human factors engineering.

(*b*) *Program Status and Planned Accomplishments*

1. Applied Human Factors

This program assesses pilot and controller performance and interaction to develop methods of enhancing the air traffic management process and reducing the risks of system errors and accidents. The program will assist in defining the role of controllers and pilots and their relation in a highly automated environment.

Aircrew Performance Enhancement and Error Reduction

During FY–1982, new methods of measuring pilot workload and performance were developed and evaluated. Definition of a baseline reference system for workload incorporating these methods was completed. This system was used to evaluate pilot-navigation system performance for generic RNAV use in support of the 1982 Navigation System Decision.

The development of human factors flight test guidelines was completed in FY–1982. Use of these will insure consistency and com-

parability between simulation experiments of advanced flight displays (including concepts for cockpit displays of traffic information and advanced navigation). These guidelines will be verified through flight tests during FY–1983.

In FY–1983, an analysis of accident and incident data bases will be used in the classification of causal factors of reduced human performance and human error in the commuter and air taxi industry. The results will be used to formulate a prioritized list of problems related to human error. This list will serve as the basis for defining future activities leading to solutions of the identified problems.

2. Advanced Sensor Technology

In FY–1981, a low-cost Global Positioning System (GPS) receiver was designed and an engineering model developed. During FY–1982 the model was flight tested to determine the requirements for a minimum performance, low-cost general aviation GPS receiver.

In FY–1983, work will begin on the construction of the critical components for a GPS Advanced Digital Receiver (ADR). The new receiver will make extensive use of high-speed digital technology to achieve performance suitable for low-cost civil aviation navigation avionics and represents a major technology breakthrough. Preliminary investigations indicate that an ADR could meet the minimum receiver requirement with low-cost design offering superior performance. This technology will also have applications beyond the field of GPS—mainly in the area of signal processing for surveillance, communications, etc.

During FY–1983, we will continue to investigate technology developments which have potential application to the Air Traffic Control (ATC) System; such as, wake vortex detection and prediction, improved surveillance systems, cockpit integration of new sensors, and future aircraft control systems.

Additionally, preliminary design work on a surveillance satellite system for ATC utilizing Mode S avionics including data signal format (to provide more complete surveillance coverage) will be initiated in FY–1983.

3. Advanced Control Concepts Technology

This research and development activity is required to support the ATC system upgrading as described in the "National Airspace System Plan." The objectives of this effort are to assure that future automation systems such as the advanced computer system, AERA and terminal automation systems, will utilize reliable fault-tolerant hardware and software technology such that random failures will not result in unsafe operations and to study the applications of computer-aided decisionmaking for the ATC process and cockpit operations. The future technology studies, which may have application to the automated ATC System, are intended to keep FAA abreast of the rapidly developing technology of computer-aided reasoning, parallel processing and fault tolerant computer systems.

In FY–1983, the development of software tools to facilitate man-machine interface experiments in highly automated ATC systems will be initiated. The design of these tools will concentrate on the experience gained in the man-machine experiments part of the Automated

En Route Air Traffic Control Program. Particular emphasis will be placed on determining the level of understanding that a controller must possess of machine functions and processes in a highly automated environment. Additionally, FY–1983 efforts will include feasibility experiments utilizing fault tolerant hardware and software applied to advanced automation applications.

Recent advances in the artificial intelligence field indicate that these systems have achieved a level of sophistication and realistic operational use to warrant thorough examinations of this technology concept for ATC applications. In FY–1983 the investigation of the theory and practices of computers that solve general problems through the application of a set of rules to a knowledge data base, which is referred to as an expert system (which includes the survey and description of expert system technology and practices as well as the conduct of an expert system approach evaluation), will be initiated. The foundation for this investigation will be the ATC rules listed in the "Federal Aviation Administration's Air Traffic Control Handbook" and its amendments. Sample ATC decisionmaking algorithms will be developed using artificial intelligence techniques and compared to the more classical approach. A report documenting the results of this comparison and recommendations for future development will be published during FY–1983.

21 SUPPORT, $3,099,000

(*a*) *Scope and Objectives*

This program includes activities which support many program areas but are not explicitly included in a specific program area. It includes in-service Air Traffic Control (ATC) simulations directed toward providing viable alternatives to existing ATC procedures involving realignment of airspace or approaches to airports for both conventional aircraft and helicopters. Additionally, studies directed toward analyzing the impact on the air traffic controller of new ATC procedures to reduce aircraft fuel consumption and the integration of the products of the ongoing development programs into the current operating ATC system are included.

(*b*) *Program Status and Planned Accomplishments*

During FY–1982, a cooperative program with NASA was continued to analyze fixed-wing and helicopter operations as they relate to crew performance and improved traffic flow, using the NASA/Ames cockpit simulators. Studies continued to improve the handling of helicopter traffic in the air traffic control system, including an analysis of separation standards and operations in terminal control areas. Increased emphasis was placed on overall FAA integration activities, along with an accelerated approach to resolution of outstanding technical issues, permitting integration planning to assure a smooth and coordinated transition to the future ATC system. During FY–1983, efforts will continue to assure proper interfaces among the existing and proposed ATC systems, to assure compatibility of individual efforts, to insure scheduled integration of major new systems, and to update previous description of ATC systems for near- and long-term scenarios.

2. ADVANCED COMPUTER, $47,000,000

This activity provides for the development of tools and techniques for performance, reliability, and availability analysis of alternative designs developed by industry for the new enhanced automation system necessary to meet the demand for air traffic control services in the late 1980's and beyond.

23 ADVANCED COMPUTER, $47,000,000

(a) *Scope and Objectives*

The objective of the Advanced Automation Program is to conduct those planning, research, development, and testing activities necessary for the implementation of a modern air traffic control (ATC) automation system capable of providing both en route and terminal services. These activities are required due to the limitations of the current 1960's generation ATC computer systems which lack the processing capacity and reliability necessary to support increasing levels of air traffic and additional automated safety and productivity functions.

(b) *Program Status and Planned Accomplishments*

System Development

During FY–1982, the Federal Aviation Administration (FAA) completed development of a system specification and conducted the evaluation analysis necessary to initiate procurement activity leading to a major upgrading of the ATC capability.

In FY–1983, the FAA will award the initial competitive contracts to develop the overall design for the upgraded system, begin coding of the software for the new system, initiate the design for the new sector suites, and provide for the incorporation of future functions.

Host Development

During FY–1982, the FAA completed specifications for replacing FAA's computer hardware (called Host) and initiated procurement activities leading to the demonstration of computer hardware capable of executing the current National Airspace System application code.

In FY–1983, the FAA will award the initial competitive contracts to industry for demonstration of host computer systems. This will include initiation of hardware and software engineering modifications necesary to increase system reliability and provide for special interfaces, factory tests, and demonstration at the FAA Technical Center.

System Engineering and Testing

During FY–1982, the FAA completed system requirements definition studies, engineering studies, evaluation planning, technology studies, and the planning and management efforts necessary to initiate procurement activity leading to system and host development contracts.

In FY–1983, the FAA will continue necessary program management activities, system engineering studies, technology studies, and transition planning studies. In addition, the development of detailed evaluation tools for both the system and host development efforts

BEST COPY AVAILABLE

will continue. These tools include the development of system simulations, definition of benchmarks and initial development of test beds. These tools will be utilized to evaluate the systems developed by industry.

3. NAVIGATION, $5,276,000

This activity provides for modernization, expansion, and improvement of the common navigation system facilities in the United States and in overseas areas where international agreements require United States participation. Work in the field of both short- and long-distance navigation and of landing systems is included. The activity is divided into two programs under which effort will be conducted. These programs are as follows:

04 Navigation
07 Approach and Landing Systems

04 NAVIGATION, $2,515,000

(a) Scope and Objectives

The Federal Aviation Administration (FAA) engineering and development navigation program is devoted to analysis, development and testing to satisfy known and anticipated requirements for air navigation services. With emphasis on safety and cost effectiveness, the program is conducted either jointly or in coordination with other government agencies.

A major portion of the program is being conducted in accordance with the areas of responsibility described in the Federal Radionavigation Plan (FRP). The primary purpose of the FRP is to provide the framework for selecting, from a number of existing or planned systems, a suitable system or mix of systems which can satisfy the diverse user requirements of the various transportation modes in the post-1995 time frame, while minimizing duplication of Government provided services. The FAA program in this area will result in an FAA preliminary recommendation to the Secretary of Transportation at the end of 1982 on the appropriate system(s) to best satisfy user operational requirements and will provide any necessary development activities to support the ultimate decision.

At present, the Very High Frequency Omnidirectional Radio Range/Distance Measuring Equipment (VOR/DME) is the international standard for short-range navigation, and its charter is being extended through 1995 by ICAO. Under the FRP, the FAA program will examine alternative navigation systems, as well as systems to supplement VOR/DME in the post-1995 time period. The candidate systems for the future system/mix role, in addition to VOR/DME, are the satellite-based Global Positioning System (GPS) and LORAN–C. The role of Omega/VLF and GPS represent the prime candidates for providing navigation coverage in oceanic areas.

Investigation of improved helicopter navigation systems in offshore and CONUS areas is continuing. In addition, low frequency navigation systems and area navigation equipments are being evaluated for helicopter applications.

(*b*) *Program Status and Planned Accomplishments*

Navigation Systems Engineering

Program activities in this area cut across specific navigation system boundaries and concern the comparison of systems, the use of a mix of different systems in a common airspace environment, and the study of advanced system applications (e.g., operational integration of the Microwave Landing System in the high-density terminal environment).

The comparison of systems requires that their performance be described in a consistent manner (the error budget) taking into account the ability of the pilot to follow each system's guidance output (the flight technical error, FTE). An initial study of the various systems error budgets including FTE was completed in FY-1982 and will be extended in FY-1983 to further determine the problems and opportunities associated with the use of a mix of navigation systems in the National Airspace System (NAS). Cockpit simulations will be conducted in FY-1983 to quantify the contribution of pilots to system performance.

In FY–1982, a study was completed to determine the impact on FAA of adopting a new system (e.g., NAVSTAR GPS or LORAN–C) as a major system for air navigation in the NAS. The results of this study and other activities described below were integrated into the FAA recommendation to the Department of Transportation (DOT) Secretary regarding the future system/mix.

LORAN–C in Civil Aviation

These activities concerned the assessment of LORAN–C as a potential VOR–DME replacement and as a supplement to navigation aids in areas of limited coverage and as a special use capability (e.g., offshore navigation for helicopters).

Work on the low-cost LORAN–C receiver design was completed in FY–1982. Activities to determine the stability of LORAN–C signals and the number of additional LORAN–C ground stations required to provide full coverage and redundancy for civil aviation were completed in FY–1982. A study to examine the effects of precipitation static, and lightning noise on LORAN–C signal reception was also concluded in FY–1982. In FY–1983, new technology avionics will be evaluated as they become available. The initial demonstration of an automated LORAN–C position reporting system for use by ATC in areas lacking radar will be completed in FY–1983 and followed by initiation of work to examine the feasibility of using the concept in other areas with expanded capabilities in an expanded role.

NAVSTAR GPS in Civil Aviation

These activities concern the assessment of NAVSTAR GPS as a candidate for the future system/mix in accordance with the decision framework of the FRP.

Interim flight tests and analyses of the operational suitability of NAVSTAR GPS for civil aviation were completed in FY–1982 in support of the FAA preliminary recommendation on the future system/mix. This work was based primarily on flight tests using the military "Z-set," and will be extended in FY–1983 to include an operational suitability evaluation of the system based on the low-cost general aviation receiver techniques developed in FY–1981/82 under the Technol-

ogy Program (16). This work will be continued in FY–1983 and could provide a valuable input to the NAVSTAR GPS minimum operational performance standards and to the 1986 final recommendation on the future system/mix. The use of differential techniques for NAVSTAR GPS by civil aviation will be investigated to determine how effective they are in improving accuracy when the course/acquisition signal degradation is implemented by the Department of Defense.

OMEGA/VLF in Civil Aviation

These activities concern developments in recognition of the use of OMEGA/VLF as an aviation navigation system.

The OMEGA Data Bank project to collect performance data over oceanic routes and to aid in approval of additional routes was completed in FY–1982.

DME Systems

These activities concern developments to enhance the capabilities of the ICAO standard DME system.

The preparation of draft Precision DME (PDME) Standards and Recommended Practices (SARPS) for inclusion to ICAO Annex 10, "Aeronautical Telecommunications" was completed in FY–1982. Technical assessments to support the approved ICAO SARPS activity will be conducted in FY–1983. The PDME is an integral part of FAA's international coordination effort in ICAO.

Helicopter IFR Navigation

During FY–1982, nonprecision approach tests, started in FY–1981, were completed in the area around the FAA Technical Center. A 3–D LORAN–C system, integrating barometric information into course deviation indicators to give vertical guidance on approach, was developed. The initial GPS test program utilizing a Phase I Z-set in helicopters was completed which supports the 1982 Federal Radionavigation Plan recommendation. Most of the navigation issues associated with current technology helicopters will have been addressed by the end of FY–1982. In FY–1983, technical cognizance will be maintained on this rapidly growing segment of aviation to assure the early identification of any new navigation requirements.

07 APPROACH AND LANDING SYSTEM, $2,761,000

(*a*) *Scope and Objectives*

Of all the phases of flight, it is the approach and landing operation that places an aircraft in its most vulnerable position, with respect to weather, terrain, and safety margin. To facilitate safe operations commensurate with weather and visibility conditions, there are approximately 700 Instrument Landing Systems (ILS) and related lighting systems installed at United States (U.S.) airports. The existing ILS has served aviation very well since the early 1940's. However, its limitations are such that it not only cannot satisfy many current requirements, but it will not meet the growth requirements of the future.

The need for a new system to meet the future requirements of all civil/military users was recognized by the Radio Technical Commission for Aeronautics (RTCA) in 1967. The RTCA findings were trans-

lated into the National Plan for the Development of a Microwave Landing System (MLS) developed jointly by the Departments of Transportation (DOT) and Defense (DOD) and the National Aeronautics and Space Administration (NASA) in 1971. This development program, under the direction of the Federal Aviation Administration (FAA), has progressed to the point that development of the civil system configurations has been completed; and operational evaluations are in progress to ease the transition to implementation. The development of the joint tactical configuration is underway using the common signal format to assure interoperability with the civil systems. In April 1978, after considering several candidate systems, the full membership of ICAO selected the MLS proposed by the U.S. and Australia for international standardization and in April 1981, endorsed the Standards and Recommended Practices (SARPS) for the new system. All of the configurations that comprise the family of MLS's have the basic capability to overcome the limitations of today's ILS. Further, they will facilitate the use of procedures which are expected to increase airport/runway capabilities and aid in noise abatement.

Several areas of airborne equipment and procedures oriented research have been brought together under an Airborne Systems Integration program to emphasize their interdependency. All are oriented to the task of providing safe, more efficient airborne equipment and procedures for the en route navigation and approach and landing phase of flight. Flight crew performance in existing and proposed cockpits, as measured by various workload techniques, will be the basis for other work more specifically aimed at the approach and landing phase. The effect of increased information capability in the cockpit, as well as potential changes in ATC procedures and equipment, will be studied in subprograms entitled Flight Deck Information Management and Cockpit Changes in the evolving NAS. The program will investigate improved cockpit instrumentation for all weather landing systems, including head-up displays. The goal is to provide a safe and efficient interface between FAA services, the flight crew and the machine (aircraft cockpit).

(*b*) *Program Status and Planned Activities*

Service Test and Evaluation Program (STEP) for MLS

In FY-1982, FAA and user operational evaluations were continued at Washington National, Philadelphia International, and Clarksburg, West Virginia, airports. User participants consisted of two commuter airlines and a helicopter operator. A number of special projects were carried out including RNAV/MLS testing and flight tests to develop TERPS criteria. In addition, the basic (wide aperture) MLS configuration at Wallops Island, Virginia, was modified to be fully compatible with the SARPS endorsed by ICAO. Also, FAA contracted for a limited quantity of lower cost, production quality, MLS airborne receivers for use in operational evaluation activities.

In FY-1983, the various operational evaluations in STEP will be continued; and documentation of the resulting operational procedures and criteria will be initiated for use in the MLS implementation program.

Flight Crew Performance

In FY-1982, FAA, with industry, government, and universities, continued developing methods of measuring flight crew workload. In FY-1983, the program will validate techniques of workload measurement for crew complement determinations in new aircraft certification and workload changes due to integration of new technology in the cockpit.

Flight Deck Information Management

In FY–1982, studies were completed cataloging the flight tasks and information required both now and in the future for air carrier, commuter and light twin general aviation aircraft. The studies began an examination of the criticality of particular information elements and how this might assist pilots in the situation where a catastrophic failure occurs. The determination of hardware requirements and potential computer algorithms for a computer-aided flight phase status monitoring system was initiated. This project will determine to what extent a computer might aid the crew in recognizing, evaluating and coping with potentially dangerous situations in increasing complex aircraft.

In FY-1983, a prototype computer aiding system will be designed for evaluation in flight simulators. This activity will be coordinated with the aircraft flight characteristics investigations addressed in Program 18.

Cockpit Changes in the Evolving NAS

In FY–1982, the flight test of an experimental model to provide weather radar information from National Weather Service weather radar to a low-cost cockpit receiver was continued. The system was demonstrated to the general aviation community with positive results. A cost/benefit study was completed to form the basis for an agency decision as to whether this service is feasible system-wide. Work continued to assure the compatibility of new FAA-designed systems and displays having cockpit impact with the aircrew.

In FY–1983, evaluation of the cockpit impact due to changing ATC, navigation and weather services will continue. Simulation studies of potentially critical equipment/flight phase combinations will be initiated with the objective of providing guidelines for system cockpit integration.

All-Weather Landing System

In FY–1982, the flight test of a Head-Up Display (HUD) was completed and provided the data base upon which the safety contributions of HUD might be evaluated. During the test and evaluation phase, representatives of industry and the airlines were exposed to the potential of this system as an aid to all-weather approach and landing operations. Simulation studies with NASA were continued to examine the capability of HUD to improve safety for extremely low visibility operations.

In FY–1983, a program will be planned to examine the applicability of advanced display symbology from the HUD development to determine the approach and landing safety benefits of using similar symbology and information in cockpit electronic displays. This activity will be coordinated with the aircraft flight characteristics investigations addressed in Program 18.

BEST COPY AVAILABLE

4. Aviation Weather, $8,068,000

This activity provides for a program coordinated with the Departments of Commerce and Defense and the National Aeronautics and Space Administration to increase the safety and efficiency of the National Airspace System (NAS) by providing weather information tailored for use by pilots and controllers.

This unique weather information is necessary to enhance safety and improve the overall performance and utility of the NAS. This activity is accomplished under a single program:

15 AVIATION WEATHER, $8,068,000

(a) Scope and Objectives

The Aviation Weather Program is aimed at progressively improving the timeliness and accuracy of weather information provided to air crews and to the Air Traffic Control (ATC) system to reduce the number of weather related accidents and incidents and to increase both system capacity and fuel savings by reducing weather related delays. Elements of the program are conducted in close cooperation with the National Weather Service (NWS). Wherever practical, the objectives of this program will be accomplished by enhancing existing and planned air traffic control and flight service station system components and facilities for the collection, processing, and dissemination of significant weather information. This approach will ensure real-time availability of weather information to the various system users, e.g., pilots, controllers, and aviation meteorologists, with minimum implementation and operational costs.

This program encompasses three major development areas; (1) enhancements to the weather data bases of the ATC system to provide pilots and controllers with the capability for rapid access to hazardous and routine weather information; (2) development of an improved national system for detecting hazardous weather phenomena through the applications of Doppler radar technology; and (3) development of ground-based automated weather observation systems to provide observations at locations where needed; such as, airports with approved instrument approaches, heliports, and offshore drilling platforms.

FAA research activities in the above areas are monitored by the Federal Coordinator for Meteorological Services and Supporting Research. This office coordinates the activities of all agencies having weather related missions and activities, including FAA's aviation weather programs related to aviation safety and the efficient use of airspace. The FAA provides a representative to the Office of the Federal Coordinator who ensures comprehensive weather planning on a national level.

(b) Program Status and Planned Accomplishments

NAS Weather Enhancements

National Airspace System (NAS) weather related enhancements include developing the capability for processing, distribution, and display of weather data to pilots, controllers, FSS specialists, and meteorologists.

In FY–1982, work continued on elements of the Aviation Weather Plan to improve the processing and distribution of weather data to pilots and controllers, including initiation of the development of a Center Weather Processor (CWP) which will interface with the Flight Service Data Processor System (FSDPS). The center weather service meteorologist will use information and automated aids from the center weather processor to analyze and interpret the weather situation and inform air traffic control.

In FY–1983, testing of weather radar contours on the Planned View Display (PVD) for use by controllers in Air Route Traffic Control Centers (ARTCC's) to assist pilots in hazardous weather avoidance will be continued and action initiated to begin the procurement process for the acquisition of the engineering model of the CWP and CWSU work station.

Weather Radar

A major activity of the weather program is the development and application of Doppler weather radars to replace existing NWS weather radars and to provide new hazardous weather detection capabilities in the NAS. FAA is participating jointly with the Department of Defense and the Department of Commerce in the development of a common use Next Generation Weather Radar (NEXRAD) to meet the common weather detection requirements of government and the public.

In FY–1982, the initial phase of NEXRAD development continued with the award of a multiple system design contract and the completion of a cost-benefit analysis of the NEXRAD requirements.

In FY–1983, development of NEXRAD will continue with the award of multiple radar concept validation contracts and the initiation of development of the system prototypes.

Joint Airport Weather Studies

The FAA, along with the National Science Foundation, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration, initiated a Joint Airport Weather Studies (JAWS) Program in FY–1982. The purpose of the program is to better understand the kinematics of thunderstorm outflows (winds and wind shear), their effects on aircraft operations and traffic flow efficiencies. The program used the latest atmospheric sensing technology developed over the past decade for the purpose of studying hazardous convective conditions responsible for the majority of weather related aircraft accidents and serious disruptions in terminal area traffic flow.

In FY–1983, analysis of JAWS data will continue with the results of aircraft probes into suspected hazardous convective areas related to hazards identified by Doppler radars. In addition, thunderstorm detection by a Lightning Tracking and Positioning System will be compared with the detection capability of weather radars.

Automation of Weather Observations (AWOS)

In FY–1982, efforts to develop improvements in the operation of the transmissometer calibrator were completed and technical data provided to the operating services.

Testing of an Automated Low Cost Weather Observation System in the Gulf of Mexico was concluded and recommendations concerning modification relating to operation in oil platform environments issued. Tests of a Lightning Position and Tracking System were concluded in FY–1982, and the system was turned over to the FAA's Southwest Region for operational use in thunderstorm avoidance activities in the Gulf of Mexico and adjacent southwest states.

Evaluations of visibility measuring equipment capable of making visibility observations in Category IIIb weather conditions were also completed, and planning for operational testing of candidate sensors will be completed in FY–1983. Tests led to specification of a hybrid transmissometer/forward scatter meter system which will be implemented at select major airports to provide visibilities down to 150 feet.

5. Aviation Medicine, $1,250,000

This activity is concerned with the analysis, assessment, and improvement of the role of the human operator in the air traffic control system, the efficiency, performance, and work environment of airmen; the safety and health of pilots and aircrew, and the safety of passengers and certain ground personnel.

19 AVIATION MEDICINE, $1,250,000

(*a*) *Scope and Objective*

This program is concerned with the analysis, assessment, and improvement of the role of the human operator in the air traffic control (ATC) system.

(*b*) *Personnel Performance and Efficiency*

Air Traffic Controller (ATC) Selection, Training, and Utilization

Development of tests used in applicant selection and for assessment during training will continue. Alternate and improved forms of existing tests will be produced. Performance of ATC candidates and academy graduates will be tracked during their training and working careers to assess the effectiveness of the selection and training programs. Studies on factors associated with ATC personnel attrition will continue and relationships between selection and training data and subsequent data on retention and skills utilization will be determined. These studies ultimately result in large savings by preventing selection of individuals who would be unlikely to complete training or by separating individuals who perform poorly during training.

Aircrew Workload and Flight Induced Stress

This project will use cockpit simulators to study the effects of fatigue on pilot performance. Realistic outside-of-cockpit tasks will be interwoven with the simulator piloting tasks. Errors in piloting tasks will be quantitfied and related to periodic assessments of fatigue and to physiological and biochemical measurements. Identification of factors contributing to cockpit errors will provide important rulemaking or policy guidance concerning flight and duty time.

Analysis and Evaluation of ATCS Training-Performance Criteria

Continuing research will be conducted to determine quantitative relationships among Academy performance/evaluation criteria and criteria measuring performance on the job. It is expected that the new Radar Training Facility will become fully operational during FY-1982 doubling the data elements for evaluation. Rebuilding and restructuring the ATC workforce adds to the importance of this task.

Comprehensive Assessment of ATCS Selection Factors

Safety in ATC operations requires continued research in developing improved procedures for selecting personnel for ATCS training. Aptitude test data and other information collected on ATCS trainees in accordance with operationally prescribed procedures will be supplemented with response data from other types of tests, questionnaires, and other instruments. Various types of modifications to the instruments and their data will be analyzed for their ability to predict Academy training performance measures.

The Relationship of Visual Scanning Activity to Lapses of Attention During the Monitoring of a Simulated ATC Radar Display

This study will use an eye movement recorder to analyze scanning patterns and to determine under what conditions critical targets are fixated without being perceived. Video tape recordings of eye movements superimposed on the radar display will be analyzed and compared with detection latencies to critical stimulus changes.

Systems Analysis and Evaluation for Automated ATCS Training at the FAA Academy

The introduction of the Radar Training Facility will lead to the use of automated instruction. Also computer based instruction (CBI) will be introduced at a large number of field ATC facilities. A considerable effort will be required to develop data collection and analysis procedures and to train regional training specialists in the use of these procedures.

SECTIONAL ANALYSIS

A bill to authorize appropriations to the Federal Aviation Administration for research, engineering and development for fiscal year 1983.

Section (a) authorizes to be appropriated from the Trust Fund for the fiscal year ending September 30, 1983 funds in the total amount of $116,690,000 as follows:

(1) $55,096,000 for air traffic control purposes;

(2) $47,000,000 for air traffc control computer and modernization;

(3) $5,276,000 for navigation purposes;

(4) $8,068,000 for aviation weather purposes;

(5) $1,250,000 for aviation medicine purposes; and

(6) such amounts as may be necessary for increases in salary, pay, retirement, and other employee benefits authorized by law.

Funds appropriated pursuant to this subsection shall remain available until expended.

Section (b) provides that notwithstanding the purposes for which funds are authorized in paragraphs (1) through (5) of subsection (a), funds authorized by such paragraphs may be used for any such other program or project for research, development, or demonstration under section 312(c) of the Federal Aviation Act of 1958 if notice of such program or project has been given to the Speaker of the House of Representatives, the Committees on Science and Technology and Appropriations of the House of Representatives, the President of the Senate, and the Committees on Commerce, Science, and Transportation and Appropriations of the Senate in a manner containing a full and complete statement of the proposed program or project and the facts and circumstances relied on in support of such program or project and (1) a period of thirty days has passed after the date such notice was received, or (2) each such committee has transmitted to the Secretary of Transportation before the expiration of such period written notice that such committee has no objection to the proposed action.

COST AND BUDGET DATA

Fiscal year:	
1982	$71,800,000
1983	116,690,000
1984	261,300,000
1985	245,900,000
1986	192,300,000
1987	171,000,000

EFFECT OF LEGISLATION ON INFLATION

In accordance with rule XI, clause 2(1)(4) of the Rules of the House of Representatives, the legislation is assessed to have no adverse in-

flationary effects on prices and costs in the operation of the national economy. A large portion of FAA expenditures are labor intensive and spending is directly related to jobs and materials. The long run economic effect of FAA expenditures for research, engineering, and development is to increase productivity, reduce delays at the Nation's airports and thereby reduce the amount of fuel used in the national aviation system.

COMMITTEE OVERSIGHT FINDINGS AND RECOMMENDATIONS

Pursuant to Clause 2(1)(3)(A), rule XI and under the authority of rule X, clause 2(b)(1) and clause (3)(f), of the Rules of the House of Representatives the following findings and recommendations are under consideration by the Committee on Science and Technology:

(Excerpted from pages 1 through 3, Science and Technology Committee Report: "Air Traffic Control En Route Computer Modernization, dated August, 1981.)

FINDING 1

The Subcommittee found virtually unanimous agreement that some form of replacement and modernization of the ATC enroute computer system is necessary. Lack of computing speed and storage capacity to handle projected future traffic, insufficient growth capacity to accommodate future system safety and productivity improvements, and increasingly expensive spare parts all lead to this conclusion. Opinion was divided as to the need for:

1. A complete hardware and software upgrade.
2. A replacement with current technology hardware.

RECOMMENDATION:

The Subcommittee concurs with the judgment that the present enroute computer system should be replaced. The FAA should quickly define the minimum requirements for such a replacement, develop acquisition plans, and seek commitment of the necessary funds. To delay only unnecessarily poses safety risks and increases the chances for breakdowns of the present systems. Such delay is not warranted particularly when the Aviation Trust Fund has a multibillion dollar reserve.

FINDING 2

The chief reason given for an interim hardware replacement was concern that the present computer system would become saturated at certain enroute centers before a full replacement could be designed, developed and installed. The Subcommittee found, however, that there is a variety of available strategies to "buy back" computer capacity by off-loading non-essential functions or by modifying the software itself. In this way, the FAA could extend the life of the current system. For this reason, the Subcommittee believes the capacity argument is insufficient to justify the cost and management complexity of an interim hardware replacement.

BEST COPY AVAILABLE

RECOMMENDATION:

The ability to prolong the useful life of the enroute computer system is limited. Development or procurement delays in the new system could seriously threaten any strategy that relies on such extension. Therefore, the FAA should prepare a "fall-back" plan to be used in the event of technical or budgetary difficulties with acquisition of the fully modernized system. Such a plan could involve a hardware-only replacement, software changes or a combination of both. The FAA should also proceed with off-loading of nonessential operations to prevent overloading of present computer capacity pending replacement of the system.

FINDING 3

As proposed, the enroute computer modernization program will be one of the largest non-military systems acquisitions ever undertaken. Unfortunately, the FAA's record of performance in this area raises questions about the agency's ability to efficiently manage the acquisition. The Subcommittee is concerned that:

1. The FAA and OMB do not fully recognize the project's complexity and have not programmed funds to assure its timely completion.
2. The FAA has not established a dedicated project operation with sufficient authority to carry out both the development and procurement phases of ATC computer replacement.
3. The acquisition schedules and plans submitted to the Subcommittee thus far, although detailed, appear to lack top level Administration commitment and are therefore subject to frequent changes in response to a variety of expediencies unrelated to the critical need for enhanced air safety.

RECOMMENDATION:

The FAA should publish without further delay a full program management plan for the development and acquisition of the enroute computer system. Such plan should include, but not be limited to, costs, schedules, milestones, organization responsibilities, technical approach, and funding plans. The plan must take into account the role of the new system in the overall air traffic control system.

FINDING 4

The key to safe operation of the ATC system is a force of highly trained professionals who operate and maintain the automated equipment. It is, in large measure, their skill, dedication to making the system perform, and innovation in overcoming problems that have been responsible for the FAA's excellent safety record. In the past, it is apparent that input from operating personnel into the systems design process was inadequate. As the ATC rebuilding process gets underway, it is essential not to repeat this mistake.

RECOMMENDATION:

The FAA should establish a mechanism whereby the judgments and experience of operating personnel and users of the air system can be included in the enroute computer development

BEST COPY AVAILABLE

process. Without such input, we run a very real risk of developing a system which would overlook day to day demands under which it will be expected to operate and ignore informational needs of of those using and relying on the system.

Finding 5

Several witnesses expressed support for an interim hardware replacement. Others contended that this would:

1. Delay implementation of the fully modernized enroute system.
2. Not be able to accommodate future fuel-saving ATC improvements.
3. Cost more in the long term.

RECOMMENDATION:

The Subcommittee is convinced that proceeding with full modernization is the best way to achieve needed productivity benefits and assure continued safe operation in the enroute airspace. Therefore, the FAA Administrator should seek a firm DOT and OMB commitment for this course of action. Furthermore, the Committee believes that funds for this project should be derived from the Airport and Airways Trust Fund. To insure that a sufficient trust fund balance is available, the FAA should recommend adequate revenue levels and should earmark the funds for this purpose.

CHANGES IN EXISTING LAW MADE BY THE BILL AS REPORTED

There are no changes in existing law made by the bill as reported.

CONGRESSIONAL BUDGET ACT INFORMATION

No information pursuant to section 308(a) of the Congressional Budget Act of 1974 has been provided to the Committee by the Congressional Budget Office. Under a separate section of this report, a five year current programs cost estimate is provided in response to the requirement of section 308(a). No funds for State or local financial assistance are included in H.R. 6721 Section 5(d).

CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

1. Bill number: H.R. 6193.
2. Bill title: A bill to authorize appropriations for fiscal year 1983 for research, engineering and development, and demonstration projects relating to aviation.
3. Bill status: As ordered reported by the House Committee on Science and Technology, May 13, 1982.
4. Bill purpose: H.R. 6193 authorizes appropriations for the Airport and Airway Trust Fund for fiscal year 1983 for research, engineering and development, and demonstrations of the Federal Aviation Administration (FAA). For these activities there is authorized $116.7

BEST COPY AVAILABLE

million for 1983. In addition, such sums as necessary are authorized for increases in salary, pay, retirement, and other employee benefits authorized by law.

5. Cost estimate:

	Millions
Estimated authorization level:	
Fiscal year:	
1983	$119.2
1984	-----
1985	-----
1986	-----
1987	-----
Estimated outlays:	
Fiscal year:	
1983	77.2
1984	35.4
1985	6.6
1986	----
1987	----

The costs of this bill fall within budget function 400.

Assuming the funding levels provided in this bill and the spending of prior years' funding, total outlays for research, engineering and development, and demonstration activities are estimated to be $94.6 million in fiscal year 1983.

6. Basis of estimate: The funds authorized for fiscal year 1983 are assumed to be appropriated prior to the beginning of the fiscal year. The fiscal year 1983 authorization provides $55.1 million for air traffic control purposes, $5.3 million for air navigation, $8.1 million for aviation weather, $1.3 million for aviation medicine, and $47.0 million for air traffic control computer modernization. To the 1983 authorization was added an additional $2.5 million in fiscal year 1983 for increases in employee benefits as authorized by law. This increase was estimated at 6.74 percent of the total personnel compensation provided by the authorization. Outlays for research, engineering, and development activities are estimated using historical spendout rates of 64.0 percent the first year, 30.3 percent the second year, and 5.7 percent the third year.

7. Estimate comparison: The Administration expects total fiscal year 1983 outlays to be $87.8 million, assuming their budget authority request of $117 million.

8. Previous CBO estimate: None.

OVERSIGHT FINDINGS AND RECOMMENDATIONS, COMMITTEE ON GOVERNMENT OPERATIONS

No findings or recommendations on oversight activity pursuant to clause 2(b)(2), rule X and clause 2(1)(3)(D), rule XI, of the Rules of the House of Representatives have been submitted by the Committee on Government Operations for inclusion in this report.

COMMITTEE RECOMMENDATION

A quorum being present, the committee unanimously approved the bill by voice vote of those present.

FAA RECOMMENDATION

This is a Federal Aviation Administration item which falls within the jurisdiction of this Committee pursuant to Rule X, clause 1(r)(9) of the Rules of the House of Representatives and is approved with exceptions noted in this report by the Administrator of the Federal Aviation Administration as indicated by the following letter:

U.S. DEPARTMENT OF TRANSPORTATION,
FEDERAL AVIATION ADMINISTRATION,
Washington, D.C., April 26, 1982.

Hon. DAN GLICKMAN,
Chairman, Subcommittee on Transportation, Aviation and Materials, Committee on Science and Technology, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: I would like to follow up on your hearings of February 23 and 24 on the National Airspace System Plan. I know that you are interested in the funding levels necessary to support the plan. Specifically, the authorizations which the Administration is seeking for 1983 are $725 million for Facilities and Equipment, and $134 million for Research, Engineering and Development.

I hope that this information is useful to you and the Subcommittee as you prepare to mark-up authorizing legislation. As always, I will be pleased to work with you and the Subcommittee on moving forward with this important matter. Please let me know if I can be of further assistance.

Sincerely,

J. LYNN HELMS,
Administrator.

○